Waste-to-energy technologies in TIMES models

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Waste-to-energy technologies in TIMES models

- European law
  1999 Directive and current proposals
- Waste potentials till 2030
  European econometric model for waste streams
- Waste treatment today (focusing on Denmark)
  Long tradition for waste incineration for district heating
- How to model waste-to-energy technologies in the Pan-European NEEDS-TIMES model
  Waste incineration for electricity and heat, landfill gas
  Technology progress
  Prices, taxes and subsidies
  Physical constraints

European legislation on waste

DIrectives

- Waste Framework Directive, 1975 (75/442/EEC)
- Directive on the landfill of waste, (1999 1999/31/EC)
  Aims on limitation of biodegradable waste by 2014 (35% of the amount produced in 1995)
- New Waste Framework Directive, 2006, (2006/12/EC)

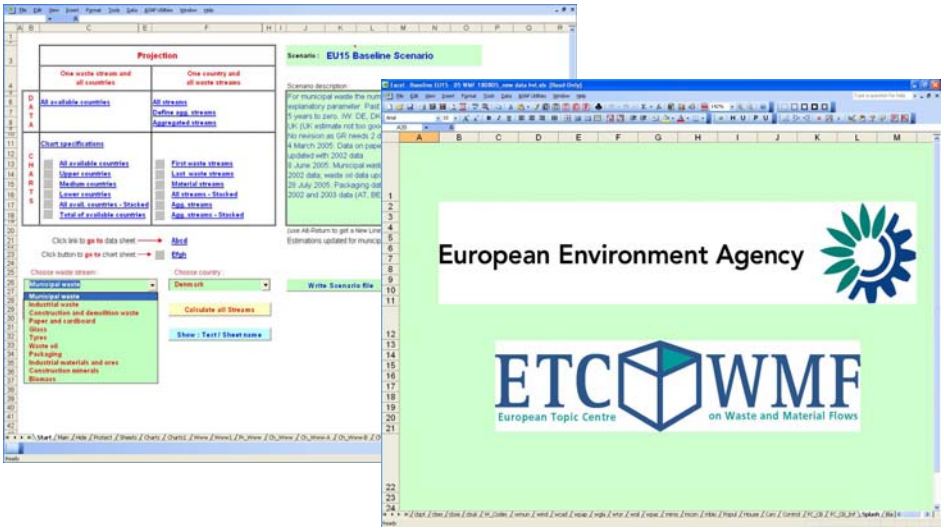
Encourage

- Prevention of waste
- Recovery of waste
- Use of waste as a source of energy

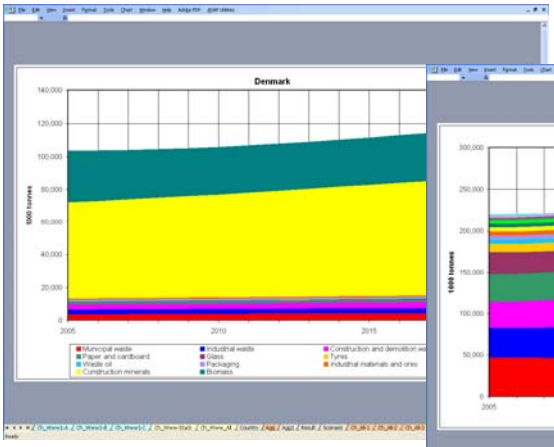
Avoid

- Landfill

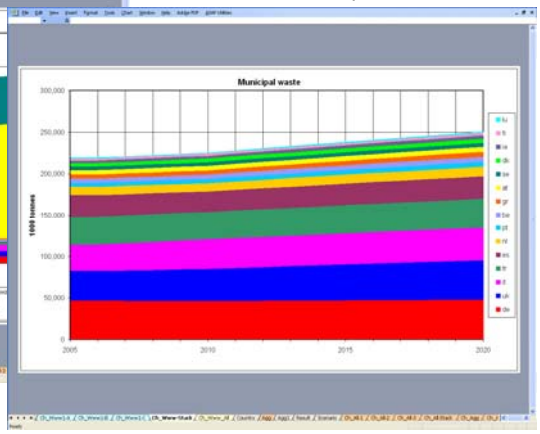
European waste model (POGR)



European waste model – Results



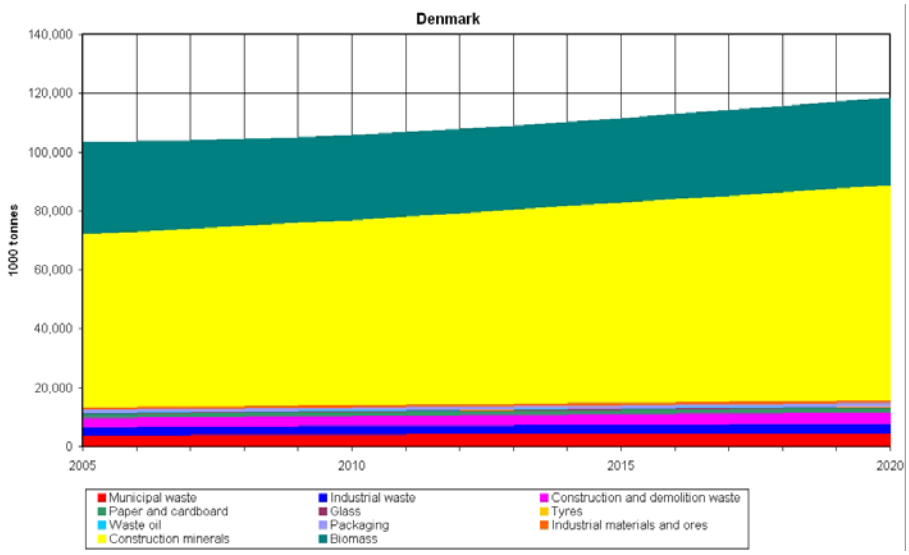
Municipal Waste: EU 15



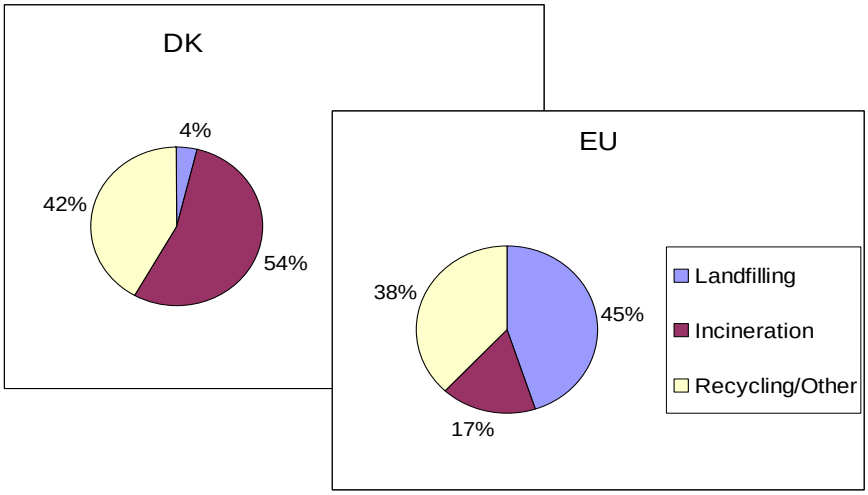
Waste: country model results

Source: "Municipal waste management and greenhouse gases" European Topic Centre on Resource and Waste Management, January 2008.

European waste model – Country model results



2004 Municipal Waste Treatment



Source: "Municipal waste management and greenhouse gases" European Topic Centre on Resource and Waste Management, January 2008.

2006 Total Waste for Energy

34 plants - 97% CHP plants, 3% DH plants
Average size – 15 MW_{el} and 37 MW_{heat}
Average efficiency – 16% electricity and 68% heat
37,5 PJ Waste to 24,5 PJ heat and 7 PJ electricity
4% of electricity production, 19% of heat production

Source: "Energy Producer Statistics" 2008 and "Energy Statistics 2006" Danish Energy Agency 2007

Urban integration of waste incineration

- The KARA waste incineration plant 30 km west of Copenhagen is located in an area zoned for light industry and retail. There is also a waste and recycling station for households and businesses. Some electricity is generated, but most energy is used for district heating for the Copenhagen regional grid.
- There are some 30 similar waste incineration plants in Denmark that supply base-load district heating all year round.

Techno-economic parameters for waste-to-energy plants

Parameters for Waste incineration plants in NEEDS-TIMES and DEA, 2005

	Tech-nology Size MW	Overall effi-ciency %	Elec-trical effi-ciency %	Power-to-heat ratio	Avail-ability %	INV-COST €/kW	FIX-OM €/kW	VAR-OM €/kW
NEEDS-TIMES	15	75%	25%	0.50	0.80	1520	74	2.56
DEA 2005								
MSW 2004	9.8	85%	23%	0.30	0.92	6759	274	6.99
MSW 2010-2015	12	95%	27%	0.34	0.93	6759	223	5.87
MSW 2020-2030	13	97%	29%	0.37	0.93	6759	205	5.31

The cost parameters in NEEDS-TIMES are some 50% higher than those for coal-fired units, which indicates that the costs of the waste treatment facilities are not considered. On the other hand, fuel costs for waste are positive in most countries.

The Danish publication “Technology Data for Electricity and Heat Generating Plants”, April 2005 is often used as a source for technology data. The Danish cost for waste is usually negative, e.g. 3 €/GJ.

Landfill gas for electricity is not explicitly considered in NEEDS-TIMES.

Issues for modelling waste-to-energy technologies

- Currently little focus on waste-to energy in TIMES models
- The size of future potentials is being considered in recent European projects, e.g. within Intelligent Energy Europe
- Investment costs reflecting the whole plant or the energy conversion part only
- Some waste streams require zero or negative prices
- Harmonisation of national parameters is needed for multi-national models
- No comparisons between waste incineration and alternatives are available from optimisation models covering the whole energy system or just electricity and heat.
- Infrastructure and public acceptance may be essential for the assumptions used in modelling of waste-to energy technologies.
- Energy prices, taxes and subsidies will be important for the optimisation results.